REMARKS

The claims have been amended to conform more closely to US practice and to add a claim to a metal core produced by the method of claim 3.

A substitute specification that employs more-idiomatic English is submitted herewith. A clean version and a version showing the changes are both submitted. The substitute specification contains no new matter.

The last name of the second inventor on the Declaration reflects a correction in the last name since the PCT application was filed.

An early examination on the merits is respectfully requested.

The Commissioner is hereby authorized to charge any deficiency in fees or to credit any overpayment in fees to Attorney's Deposit Account No. 50-0562.

Respectfully submitted,

Date: 1 - 3 - 06

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SPECIFICATION

RUBBER CRAWLER TRACK AND METHOD OF PRODUCING ~~CORE METAL~~ METAL CORE FOR RUBBER CRAWLER TRACK

TECHNICAL FIELD

【0001】 The present invention relates to a rubber crawler track mounted on an endless track traveling device, which is used in mobile construction machines, civil working vehicles, farm working machines, and industrial vehicles such as transportation vehicles, and a method of producing ~~a core metal~~metal core for the rubber crawler track.

TECHNICAL BACKGROUND

【0002】 Fig. 11 shows a conventional rubber crawler track C. Steel cords S are embedded in a rubber crawler body shaped as an endless belt from a~~out of~~ rubber elastic body as ~~a~~ circumferential reinforcing members, and metallic ~~core metals~~ cores M are embedded therein as ~~a~~ width directional reinforcing members. K is a guide protrusion for guiding a rolling wheel.

In the conventional rubber crawler track, as shown in Fig. 12A, side displacement occurs between adjacent ~~core metals~~metal cores. Because of the side displacement, a rolling wheel R of a crawler traveling device goes across the guide protrusion K to run off, and the rubber crawler track comes off~~to get out of~~ the traveling device.

In addition, the conventional rubber crawler track is so constructed, as shown in Fig. 12B, that the rolling wheel R rolls on the guide protrusions K. Therefore, the rolling wheel R rolls on the guide protrusions K, sinking~~collapsing~~ between the ~~core metals~~metal cores adjoining longitudinally in a circumferential direction and thereby~~to~~ increasing~~e~~ traveling vibration. To solve this problem, a rubber crawler track for reducing the sinking~~collapse~~ of the rolling wheel has been proposed. Therein, the~~a~~ rolling face of the guide protrusion is extended circumferentially, the guide protrusion is T-shaped ~~in T letter~~, and the~~a~~ distance between the ~~core metals~~metal cores is shortened. However, as to even

this structure, the ~~core metals~~metal cores incline and the rolling wheels sink~~collapse~~ after all.

【0003】 ~~This applicant has already proposed a~~An invention disclosed in Japanese utility model registration No. 2551937 has been proposed to prevent wheel run-off caused by the side displacement of~~in~~ the rolling wheel. The~~is~~ invention is to prevent the side displacement of the rubber crawler track and the wheel run-off by arranging horizontal protrusions MP onto~~to~~ a ~~core metal~~metal core M. In~~(See~~ Fig. 13A, MY is a ~~core metal~~metal core wing portion.~~)~~

In addition, ~~the applicant has proposed~~ an invention disclosed in Japanese patent No. 2554552 and Japanese utility model publication No. 000226 of 1996 has been proposed to prevent traveling vibration due to the sinking~~collapse~~ of the rolling wheel and the~~an~~ inclination of the ~~core metal~~metal cores. In this invention, the top of the guide protrusion K forms an inclination KT to form a continuous rolling wheel track and reduce the vibration. That is, when the rolling wheel R gets on guide protrusion overhangs KP, the overhangs KP gravitate somewhat to keep the height of track of the rolling wheel and approach ~~to~~ the guide protrusion K of the adjacent ~~core metal~~metal core M to reduce the distance between the ~~core metals~~metal cores. In~~(See~~ Fig. 14, MK is an engaging portion of the ~~core metal~~metal core.~~)~~

【0004】 Moreover, ~~the applicant has proposed~~ an invention disclosed in Japanese utility model registration No. 2601638 has been proposed to settle the following problems.

Problem 1:

When the rolling wheel travels on the guide protrusions of the rubber crawler track, an external force such as a rolling wheel load is added on crawler circumferential ends of the guide protrusion top. According to this, the guide protrusion inclines, the rolling wheel sinks~~collapses~~, and the traveling vibration occurs.

Problem 2:

The ~~core metal~~metal core comes~~falls~~ off ~~from~~ the rubber crawler track in~~at~~ a stroke due to an~~the~~ external force like a pushing~~-~~ up from the side of the guide protrusion, caused by the~~an~~ interaction between the crawler track and the traveling device. Here, the

interaction is caused by ~~pushing~~ stones pushing between the guide protrusions or by the discrepancy of the traveling device. In this case, sometimes, ~~an~~ adhesion between the rubber and the ~~core metal~~metal core is overcome, and the metal core is peeled away.

In the invention of Japanese utility model registration No. 2601638, the horizontal protrusions MP are formed within the thickness of the wing portion of the ~~core metal~~metal core embedded in the rubber crawler track or below it so as to cross perpendicularly to the side ~~plane~~ of the ~~core metal~~metal core. When the ~~core metal~~metal core is embedded in the rubber crawler body, ~~the~~ horizontal protrusions MP between the adjacent ~~core metals~~metal cores are embedded so as to overlap in a crawler width direction (lateral direction) and in a crawler thickness direction (vertical direction). Therefore, a local side displacement of the rubber crawler track and vibration of the ~~core metal~~metal core are prevented, thereby preventing the crawler run-off, the rolling wheel sinking~~collapse~~, and the ~~core metal~~metal core peel-off~~.~~ (See Fig. 13B). Reference is made to

~~Patent literature 1:~~ Japanese utility model registration No. 2551937,

~~Patent literature 2:~~ Japanese utility model registration No. 2601638,

~~Patent literature 3:~~ Japanese patent No. 2554552, and

~~Patent literature 4:~~ Japanese utility model publication No. 000226 of 1996.

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

【0005】 The rubber crawler track in Japanese utility model registration No. 2601638 can solve the following conventional problems.

(1) The problem~~,~~ in which the side displacement occurs between the adjacent ~~core metals~~metal cores, the rolling wheel of the crawler driving device goes across the guide protrusion of the ~~core metal~~metal core to run off, and the rubber crawler track comes off~~gets out of~~ the driving device.

(2) The problem~~,~~ in which the traveling vibration is increased by the sinking~~collapse~~ between the adjacent ~~core metals~~metal cores of the rolling wheel and by the inclination of the ~~core metal~~metal cores.

(3) The problem~~,~~ in which the ~~core metal~~metal core comes~~falls~~ off ~~from~~ the rubber crawler track due to the vibration.

However, this horizontal protrusion has only a small section modulus, and therefore, there is an uneasiness in the strength of protrusion.

【0006】 In addition, the conventional rubber crawler track has the following problems.

Generally, a rubber crawler track transmits a driving force from the driving device to the rubber crawler track by~~as~~ engaging sprocket teeth of the driving device with~~to~~ the engaging portion of the ~~core metal~~metal core.

When transmitting the driving force to the ~~core metal~~metal core, there occurs adhesive fatigue on a shearing face between the ~~core metal~~metal core and a steel cord layer, and the ~~core metal~~metal core comes ~~falls~~ off. This problem needs preventing effectively.

【0007】 In addition, it is impossible to apply the~~a~~ structure for improving the traveling vibration, which is disclosed in Japanese patent No. 2554552 or Japanese utility model publication No. 000226 of 1996, to the ~~core metal~~metal core having horizontal protrusions disclosed in Japanese utility model registration No. 2601638~~.~~, ~~B~~because the~~a~~ mold shape for producing ~~core metals~~metal cores is restricted.

In molding the ~~core metals~~metal cores of Fig. 14, which have the structure disclosed in Japanese patent No. 2554552 or Japanese utility model publication No. 000226 of 1996, the~~a~~ parting plane of the mold must be formed at the~~a~~ line position in Fig. 15A so as to part vertically. However, in molding the ~~core metals~~metal cores for improving the wheel run-off, which is disclosed in Japanese utility model registration No. 2601638, the parting plane must be formed at the~~a~~ line position in Fig. 15B so as to part laterally on forming the horizontal protrusions. Therefore, the height of the guide protrusion top at the center of the ~~core metal~~metal core becomes maximized~~the most high~~ because a trimming taper is formed. Consequently, the traveling vibration is increased.

The present invention aims to solve the above-mentioned problems and provide a rubber crawler track in which a local side displacement is more effectively prevented to

effectively prevent wheel run-off, which can improve traveling vibration, and in which separation of ~~a core metal~~metal cores is prevented for improved durability of the rubber crawler track and for reduced costs.

MEANS TO SOLVE THE PROBLEM

【0008】 The present invention is achieved for the above-mentioned aims.

Generally, a rubber crawler track comprises an endless belt-shaped rubber crawler body made of a rubber elastic body and the like, many steel cords stratifiedly embedded therein, and ~~core metals~~metal cores embedded at a fixed interval in the~~a~~ crawler circumferential direction.

A ~~core metal~~metal core used in the present invention is provided with horizontal protrusions. The horizontal protrusions are provided on~~to~~ sides ~~planes~~ of the ~~core metal~~metal core in the width direction on~~of~~ at least one of two~~both~~ sides of an engaging portion of the ~~core metal~~metal core, ~~where are~~ within the thickness of ~~core metal~~metal core wing portions in the vertical direction and an area on~~of~~ the tread side below ~~than~~ the thickness. When the ~~core metal~~s are embedded in the rubber crawler body, ends of horizontal protrusions facing each other between adjacent ~~core metals~~metal cores in the circumferential direction overlap in a crawler width direction and in a crawler thickness direction within a fixed length.

The first feature of the invention is to express a distance “r” between the ends of the horizontal protrusions in the crawler circumferential direction as $\Delta r \leqq r \leqq 2\Delta r$. In this case, the rubber crawler track is horizontal.

Here, Δr is obtained by $\Delta r = 2\pi h / n$ where “h” is a distance from a steel cord layer to the horizontal protrusion, and “n” is the number of the sprocket teeth of the traveling device.

Accordingly, the distance “r” is expressed as $2\pi h / n \leqq r \leqq 4\pi h / n$.

【0009】 The second feature of the present invention is to form a tapered horn portion on~~to~~ an end of one of the horizontal protrusions facing ~~between~~ the adjacent ~~core metals~~metal cores.

【0010】 The third feature of the present invention is to shift a parting plane of a mold for producing~~ core metals~~metal cores left and right from the center at guide protrusion sides due to shifting left and right guide protrusions of the crawler width direction of the~~ core metals~~metal cores longitudinally in the crawler circumferential direction so as to shift the highest positions of the guide protrusions longitudinally in the crawler circumferential direction from the center of the~~ core metals~~metal cores.

EFFECT OF INVENTION

【0011】 According to the above-mentioned first feature, ~~a~~ shearing force transmitted from a sprocket is dispersed, thereby preventing the~~ core metal~~metal core from separating from the rubber crawler track. In addition, it is possible to reduce the shearing area between the~~ core metal~~metal core and the steel cords and reduce the cost.

【0012】 In addition, according to the above-mentioned third feature, the height of the guide protrusion top on the center line in the~~a~~ crawler longitudinal direction of the~~ core metal~~metal core can be lowered so as to shape a rolling contact surface of the rolling wheel with the left and right guide protrusions in~~of~~ the~~ core metal~~metal core longitudinal direction. Therefore, ~~the~~ traveling vibration can be effectively prevented. Hence, it is possible to prevent ~~the~~ traveling vibration in even ~~the core metals~~metal cores with the horizontal protrusions.

BRIEF EXAMINATION OF THE DRAWINGS

【0013】 ~~[~~Fig. 1~~]This~~ shows a~~ core metal~~metal core to be embedded in a rubber crawler body~~,~~ Fig. 1A is a front view~~,~~; Fig. 1B is a side view~~,~~; and Fig. 1C is a plane view of a side opposite the tread~~an anti-tread~~ side of a~~ core metal~~metal core to be embedded in a rubber crawler track. (The first embodiment)

~~[~~Fig. 2~~] This~~ is a perspective view of the ~~core metal~~metal core to be embedded in the rubber crawler body. (The first embodiment)

~~[~~Fig. 3~~] This~~ shows the rubber crawler track~~,~~. Fig. 3A is a plane view of a side opposite the tread~~the anti-tread~~ side~~,~~; Fig. 3B is a sectional view taken along line X-X ~~line~~ of Fig. 3A~~,~~; and Fig. 3C is a side view of Fig. 3A. (The first embodiment)

~~[~~Fig. 4~~]~~ ~~This~~ is a view for explaining the horizontal protrusions between the adjacent ~~core metals~~metal cores embedded in the rubber crawler body. Fig. 4A is an explanatory~~ion~~ view of the sides ~~plane~~ of ~~the~~ adjacent ~~core metals~~metal cores while the crawler track contacts on the ground (in a horizontal state). Fig. 4B is an explanatory~~ion~~ view thereof while the crawler track is wound around~~up to~~ an idler-sprocket of the traveling device. (The first embodiment)

~~[~~Fig. 5~~]~~ ~~This~~ is a view for explaining the horizontal protrusions between the adjacent ~~core metals~~metal cores embedded in the rubber crawler body. Fig. 5A is an explanatory~~ion~~ view of the side ~~plane~~ showing the relation of the adjacent ~~core metals~~metal cores while the crawler track contacts on the ground (in a horizontal state). Fig. 5B is an explanatory~~ion~~ view of the sides ~~plane~~ showing the relation of the adjacent ~~core metals~~metal cores while the crawler track is wound around~~up to~~ the idler-sprocket of the traveling device. (An ~~an~~other embodiment of the first embodiment)

~~[~~Fig. 6~~]~~ ~~This~~ is a graph ~~view~~ showing a ratio of load for the sprocket teeth in transmitting traction capacity from the sprocket to the rubber crawler track.

~~[~~Fig. 7~~]~~ ~~This~~ is an explanatory~~ion~~ view of a ~~core metal~~metal core ~~for~~ showing a parting plane of a mold for producing the ~~core metal~~metal core. Fig. 7A is a plane view of the anti-tread side of the ~~core metal~~metal core embedded in the rubber crawler track;~~,~~ Fig. 7B is a side view; and Fig. 7C is a plane view of the tread side. (The first embodiment)

~~[~~Fig. 8~~]~~ ~~This~~ is a graph ~~view~~ showing the rolling-wheel sinkage of a ~~core metal~~metal core whose guide protrusion top forms a trimming taper from the center, produced by a conventional laterally parting mold, and a ~~core metal~~metal core whose guide protrusion is shifted in the crawler circumferential direction and whose parting plane is shifted at the guide protrusion side in the present invention. (The first embodiment)

~~[~~Fig. 9~~]~~ ~~This~~ shows a ~~core metal~~metal core to be embedded in the rubber crawler body~~,~~. Fig. 9A is a plane view of ~~the~~ a side opposite the tread~~anti-tread side~~, and Fig. 9B is a side view. (The second embodiment)

~~[~~Fig. 10~~]~~ ~~This~~ is a view for explaining the horizontal protrusions

between the adjacent~~core metals~~metal cores embedded in the rubber crawler body. Fig. 10A is an explanatory~~ion~~ view of the side, ~~plane~~ showing the relation of the adjacent~~core metals~~metal cores while the crawler track contacts ~~on~~ the ground (in a horizontal state). Fig. 10B is an explanatory~~ion~~ view of the side ~~plane~~ showing the relation of the adjacent ~~core metals~~metal cores while the crawler track is wound around~~up to~~ the idler-sprocket of the traveling device. (The second embodiment)

~~【~~Fig. 11~~】This~~ is a partly sectional fragmentary perspective view of a~~the~~ rubber crawler track. (Conventional embodiment)

~~【~~Fig. 12~~】This~~ is a view for explaining problems~~troubles~~ of the rubber crawler track. Fig. 12A is a plan~~e~~ view for explaining the problem~~a trouble~~ that the rubber crawler track comes off~~gets out of~~ the traveling device. Fig. 12B is a side view for explaining the problem~~a trouble~~ that traveling vibration of the rubber crawler track gets louder~~loudens~~. (Conventional embodiment)

~~【Fig. 13】~~Fig. 13A and Fig. 13B are perspective views of ~~the~~ conventional~~core metals~~metal cores for overcoming~~to settle~~ the problems~~troubles~~ of the rubber crawler track. (Conventional embodiment)

~~【Fig. 14】~~ Fig. 14A and Fig. 14B are perspective views of ~~the~~ conventional~~core metals~~metal cores for overcoming~~to settle~~ the problems~~troubles~~ of the rubber crawler track. (Conventional embodiment)

~~【~~Fig. 15~~】This~~ is a side view of the~~core metal~~metal core for explaining a parting plane of a~~the~~ conventional mold. (Conventional embodiment)

~~EXPLANATION OF REFERENCE MARKS~~

~~【0014】 1 a rubber crawler track~~

~~2 a rubber crawler body~~

~~3, 3' a core metal~~

~~3a, 3a' a core metal engaging portion~~

~~3b, 3b' a core metal guide protrusion~~

~~3c, 3c' a core metal wing portion~~

~~4a lug~~

~~5a steel cord~~

~~6a core metal horizontal protrusion~~

~~C a conventional rubber crawler track~~

~~H a conventional rubber crawler body~~

~~M a conventional core metal~~

~~MY a conventional core metal wing portion~~

~~MK a conventional core metal engaging portion~~

~~K a conventional core metal guide protrusion~~

~~KP a conventional core metal guide protrusion buckling portion~~

~~KT a conventional core metal guide protrusion slope~~

~~R a rolling wheel~~

~~S a steel cord~~

PREFERRED EMBODIMENTS OF THE INVENTION

【0015】 A rubber crawler track comprises an endless belt-shaped rubber crawler body made of a rubber elastic body, many steel cords and ~~core metals~~metal cores. The steel cords are embedded in the rubber crawler body so as to form a layer. The ~~core metals~~metal cores are embedded at a fixed interval in a circumferential direction of the rubber crawler track, each comprising an engaging portion, guide protrusions for preventing wheel run-off, wing portions and horizontal protrusions. The engaging portion is formed at the center of the length of ~~a core metal~~the metal core, and the guide protrusions and the wing portions are respectively formed on~~to~~ both sides of the engaging portion. The horizontal protrusions are provided on~~to~~ sides ~~planes~~ of the ~~core metal~~metal core in the width direction on~~of~~ at least one of the~~both~~ sides of the engaging portion ~~where are~~ within the thickness of ~~core metal~~metal core wing portions in the vertical direction and an area on the~~of~~ tread side below ~~than~~ the thickness. When the horizontal protrusions are embedded in the rubber crawler body, they face each other between the

adjacent ~~core metals~~metal cores in the crawler circumferential direction~~.~~, ~~A~~and the ends of the horizontal protrusions overlap in the~~a~~ crawler width direction and in the~~a~~ crawler thickness direction within the fixed length. In this case, a distance "r", in the circumferential direction of the rubber crawler track, between the ends of the horizontal protrusions facing each other between the adjacent ~~core metals~~metal cores is expressed as $\Delta r \leqq r \leqq 2\Delta r$. In this case, the rubber crawler track is horizontal.

Δr is calculated by $\Delta r = 2\pi h / n$ ("h" is a distance from a steel code layer embedded in the rubber crawler body to the horizontal ~~core metal~~metal core, and "n" is the number of sprocket teeth of the driving device).

Accordingly, when the rubber crawler track is engaged with the sprocket, there comes to be no space between the ends of the horizontal protrusions of the adjacent ~~core metals~~metal cores. Therefore, the shearing force applied~~participated~~ when the driving force is transmitted from the sprocket teeth to the ~~core metal~~metal core engaging portion does not concentrate on a ~~core metal~~metal core but disperses to the adjacent ~~core metals~~metal cores through the horizontal protrusions. The shearing force is ~~to be~~ dispersed to a next ~~core metal~~metal core through the horizontal protrusions one after another. Therefore, the ~~core metals~~metal cores are prevented from separating from the rubber crawler track.

In addition, it is possible to reduce the shearing area between the ~~core metals~~metal cores and the steel cords, and reduce the cost.

【0016】 Moreover, in the present invention, an end of the horizontal protrusion of one side of longitudinal ones in the crawler circumferential direction (in the ~~core metal~~metal core width direction) may have a tapered horn portion. When the ~~core metals~~metal cores are embedded in the rubber crawler body, the ends of the horizontal protrusions overlap within the fixed length in the crawler width direction and in the crawler thickness direction in the state that one of them facing between the adjacent ~~core metals~~metal cores has the horn portion and the other has none.

Therefore, when the crawler is wound around~~up to~~ the idler or the sprocket, the horizontal protrusions do not interfere with the ~~core metals~~metal cores, and therefore, the

distance from the horn portion to the adjacent~~ core metal~~metal core is reduced so that the crawler track contacts on the ground (in horizontal state). Therefore, the distance by which~~that~~ the horizontal protrusions overlap between the adjacent~~ core metals~~metal cores is increased, and the overlapping state can be effectively maintained. Accordingly, crawler departure is effectively prevented.

Besides, when the distance "r" is within $\Delta r \leqq r \leqq 2\Delta r$, there is no space between the ends of the horizontal protrusions between the adjacent~~ core metals~~metal cores when~~in the state~~ the rubber crawler track is wound around~~up on~~ the idler sprocket. The shearing force participated when the driving force is transmitted from the sprocket teeth to the~~ core metal~~metal core engaging portion does not concentrate on a~~ core metal~~metal core but disperses to the adjacent~~ core metal~~metal core through the horizontal protrusions. The shearing force is dispersed to the next~~ core metal~~metal core through the horizontal protrusions one after another. Therefore, the~~ core metals~~metal cores are prevented from separating from the rubber crawler track.

【0017】 Furthermore, left and right guide protrusions in the crawler width (core metal longitudinal) direction of the~~ core metal~~metal core are shifted longitudinally in the crawler circumferential (core metal width) direction, and the highest position is shifted longitudinally from the center of the~~ core metal~~metal core. Therefore, when the~~ core metals~~metal cores are embedded in the rubber crawler track, the guide protrusions are arranged in zigzag. Accordingly, the parting plane of the mold is shifted laterally from the center of the~~ core metal~~metal core at the guide protrusion side.

Generally, producing the~~ core metal~~metal core with the complicated-shaped horizontal protrusions needs to form the parting plane of the mold so as to part laterally because a trimming taper needs to be formed to extract the~~ core metal~~metal core from the mold. On the contrary, producing the~~ core metal~~metal core disclosed in Japanese patent No. 2554552 and Japanese utility model publication No. 000226 of 1996 needs to form the parting plane so as to part vertically with relations between the shape of the guide protrusion top and the trimming taper of the parting plane. Accordingly, it is impossible to adopt the shape of the guide protrusion disclosed in Japanese patent No. 2554552 and

Japanese utility model publication No. 000226 of 1996 to the ~~core metal~~metal core with horizontal protrusions because of restriction on producing. Therefore, the parting plane of the mold must be parted laterally for the ~~core metal~~metal core with the horizontal protrusions, and therefore, the guide protrusion top is the ~~most~~ highest at the center of the ~~core metal~~metal core, and ~~the~~ traveling vibration is increased.

The height of the guide protrusion top can be lowered on the center line of the crawler longitudinal direction of the ~~core metal~~metal core by shifting the left and right guide protrusions in the crawler width direction longitudinally in the crawler circumferential direction and laterally shifting the parting plane of the mold at the guide protrusion side. In this case, ~~the~~ traveling vibration due to the shape of the rolling face disclosed in Japanese patent No. 2554552 and Japanese utility model publication No. 000226 of 1996 can be effectively prevented. Accordingly, even ~~core metal~~metal cores with the horizontal protrusions can prevent ~~the~~ traveling vibration.

【0018】 Besides, as to the shape of the horizontal protrusions, it is desirable that one of the horizontal protrusions of the adjacent ~~core metals~~metal cores in the crawler circumferential direction is L-shaped ~~as an L letter~~ and the other is shaped as a converse L ~~letter~~.

Therefore, the overlap portions of the horizontal protrusions facing ~~between~~ the adjacent ~~core metals~~metal cores in the crawler circumferential direction are positioned near the steel cord layer of a bending center of the rubber crawler track. Accordingly, the crawler coming-off can be effectively prevented. Besides, when the idler and the sprocket wind~~s~~ and reversely bend, cracks occur on the rubber portion of the rubber crawler track because the horizontal protrusions mutually shift at the overlap portion. However, the rubber crawler track can be prevented from being damaged by spread of the cracks.

In addition, the section modulus can be enlarged more than ~~the~~ usual ~~case~~ due to the horizontal protrusion being L-shaped ~~as an L letter~~, thereby increasing the strength.

EXAMPLE 1

【0019】 The present invention is explained in detail with reference to the figures

as follows~~the following in detail~~.

Fig. 1 shows a ~~core metal~~metal core 3 to be embedded in a rubber crawler body 2 (Fig. 3B) of a rubber crawler track 1 (Fig. 3A) in the first embodiment. Fig. 1A is a front view~~,~~; Fig. 1B is a side view~~,~~; and Fig. 1C is a plane view of a side opposite the tread~~the anti-tread side~~ of the ~~core metal~~metal core 3 embedded in the rubber crawler track. Fig. 2 is a perspective view of the ~~core metal~~metal core 3. Fig. 3 shows the rubber crawler track 1 in the first embodiment. Fig. 3A is a plane view of a side opposite the tread~~the anti-tread side,~~; Fig. 3B is a sectional view taken along X-X of Fig. 3A~~,~~; and Fig. 3C is a side view of Fig. 3A.

The rubber crawler track 1 comprises the rubber crawler body 2 of an endless belt body formed by a rubber elastic body, ~~the core metals~~metal cores 3, lugs 4 and steel cord 5 rows. The ~~core metals~~metal cores 3 are embedded in the rubber crawler body 2 at a fixed interval in the crawler circumferential direction. The lugs 4 protrude from the tread side of the rubber crawler track 1. The steel cord 5 rows are so formed that many steel cords 5 are divided to the left and right of ~~core metal~~metal core engaging portions 3a that~~for~~ engage~~ing~~ ~~with~~ a driving wheel of a travelling device and are embedded as a layer in the crawler circumferential direction on the outer periphery of the ~~core metals~~metal cores 3.

【0020】 The ~~core metal~~metal core 3 comprises an engaging portion 3a, guide protrusions 3b for preventing wheel run-off, left and right wing portions 3c, and horizontal protrusions 6, which are more specifically designated 6a-6d, according to their positions on the metal core. The engaging portion 3a is provided at~~to~~ the center of the length direction of the ~~core metal~~metal core. The guide protrusions 3b~~a~~ and the wing portions 3c are provided on~~to~~ both sides of the engaging portion 3a. The horizontal protrusions 6 are provided on~~to the~~ sides~~-planes~~ of the ~~core metal~~metal core in the width direction of at least one of the~~both~~ sides of the engaging portion 3a where are within the thickness of the wing portion in the vertical direction and the tread~~anti-tread~~ side portion below ~~than~~ the thickness.

The horizontal protrusions 6 facing between the adjacent ~~core metals~~metal cores

in the crawler circumferential direction of the first embodiment are overlapped within the fixed length in the crawler width direction and in the crawler thickness direction of the~~-core metal~~metal core 3. As for the shape of the horizontal protrusion 6, .a horizontal protrusion 6a of one side (left side in Fig. 1A) in the~~-core metal~~metal core longitudinal direction is L-shaped ~~as an L letter~~, and a horizontal protrusion 6b in the other side (right side in Fig. 1A) is shaped as a converse L ~~letter~~. In the~~-core metal~~metal core width direction, the distance between the left and right horizontal protrusions (the distance 6c-6d) in the~~-core metal~~metal core longitudinal direction of one side is fitted to the distance between the left and right horizontal protrusions (the distance 6a-6b) in the~~-core metal~~metal core longitudinal direction of the other side. In addition, as for the shape of the left and right~~-core metals~~metal cores in the~~-core metal~~metal core width direction, the horizontal protrusion 6a of the one side (downside of Fig. 1C) is L-shaped ~~as an L letter~~, and a horizontal protrusion 6c of the other side (upside of Fig. 1C) is shaped as a converse L ~~letter~~.

【0021】 Accordingly, the overlap of the horizontal protrusions facing between the adjacent~~-core metals~~metal cores in the crawler width direction is not varied much in winding or conversely bending the idler and the sprocket, thereby preventing side displacement suitably. In addition, the rubber portion at the horizontal protrusions is prevented from crackings~~s~~. Therefore, the rubber crawler track is improved~~can improve~~ in durability.

In addition, the horizontal protrusions are so constructed that ones facing between the adjacent~~-core metals~~metal cores overlap in the crawler width direction and in the crawler thickness direction when they are embedded in the rubber crawler body. Accordingly, the crawler track can be prevented from twisting, as well as from ~~in addition to the~~ side displacement and~~-core metal~~metal core separation due to external force~~the outer power~~. Besides, although the overlap against twisting~~the twist~~ of the horizontal protrusions facing at one place forms only one side (such as clockwise), the overlap due to the facing horizontal protrusion is on the opposite side (anti-clockwise). Accordingly, the crawler track can be prevented from twisting synthetically.

【0022】 Fig. 4 is a view for explaining the horizontal protrusions between the adjacent~~ core metals~~metal cores 3 embedded in the rubber crawler body 2 in the first embodiment. Fig. 4A is an explanatory~~ion~~ view of a side ~~plane~~ of the adjacent~~ core metals~~metal cores while the crawler track contacts ~~on~~ the ground (in a horizontal state). Fig. 4B is an explanatory~~ion~~ view of the side ~~plane~~ of the adjacent~~ core metals~~metal cores while the crawler track is wound around~~up to~~ the idler and the sprocket of the traveling device.

A distance "r" in the first embodiment is 1.6mm (Δr). ~~(~~The distance from the steel cord 5 layer embedded in the rubber crawler body to the horizontal protrusion~~;~~ is 6mm~~,~~; the number of teeth of the sprocket of the traveling device~~;~~ is 23~~,~~; and $\Delta r = 2 \times 3.14 \times 6 / 23 = 1.64$mm.~~)~~

In this case, since the rubber crawler track is usually produced through a straight pressure-hot forming ~~in straight~~, ~~there exists~~ rubber exists between the end of the horizontal protrusion and the adjacent~~ core metal~~metal core . Therefore, in consideration of compressive degree, it is preferable that the distance "r" is set from Δr to 2Δr longer than Δr. Here, Δr is the distance from the end of the horizontal protrusion to the adjacent~~ core metal~~metal core , Δr being essentially 0 when the rubber crawler track is wound around~~up to~~ the sprocket-winding portion. ~~(~~In the first embodiment, "r" is from 1.6mm to 3.2mm.~~)~~

When setting a distance r1 from the end of the horizontal protrusion to the adjacent~~ core metal~~metal core between the~~ core metals~~metal cores ~~adjoining~~ at ~~the~~ a side opposite the tread~~anti-tread side~~ and a distance r2 on~~of~~ the tread side from Δr to 2Δr as shown in Fig. 5, these distances become effectively-essentially 0 when the rubber crawler track is wound around~~up to~~ the sprocket-winding portion.

【0023】 The distance between the~~ core metal~~metal core and the end of the horizontal protrusion between the adjacent~~ core metals~~metal cores essentially ceases to exist~~loses~~ when the rubber crawler track is wound around~~up to~~ the sprocket-winding portion. According to this, the shearing force occurring when the driving force is transmitted from the sprocket teeth to the~~ core metal~~metal core engaging portion is

dispersed to the adjacent ~~core metal~~metal core through the end of the horizontal protrusion. Therefore, the ~~core metals~~metal cores are prevented from separating from the rubber crawler body.

Fig. 6 is a graph ~~view~~ showing a ratio of load for each tooth of the sprocket when traction capacity is transmitted from the sprocket to the rubber crawler track.

As shown in Fig. 6, a tractive force is not transmitted equally to the rubber crawler track from the teeth of the sprocket. The No. 10 tooth ~~of No. 10~~ shows the maximum shearing ratio.~~, namely~~ Thus, the tractive force is ~~to be~~ concentratively transmitted to the rubber crawler from a part of the teeth.

Accordingly, the shearing force caused by the tractive force (the driving force), which is concentratively transmitted from a part of the sprocket teeth to the ~~core metal~~metal core engaging portion, is dispersed from the ~~core metal~~metal core receiving the tractive force to the adjacent ~~core metal~~metal core through the end of the horizontal protrusion by ~~essentially losing~~ the distance from the end of the horizontal protrusion to the ~~core metal~~metal core essentially ceasing to exist when winding the rubber crawler track around~~up to~~ the sprocket-winding portion. The shearing force is further dispersed to ~~the next core metal~~succeeding metal cores in order. Therefore, the ~~core metal~~metal cores can be prevented from separating from the rubber crawler body.

In addition, when the driving force is transmitted from the sprocket teeth to the ~~core metal~~metal core engaging portion, a separating force of the ~~core metal~~metal core in a crawler inner peripheral direction can be dispersed to the adjacent ~~core metals~~metal cores by the overlap in the crawler thickness direction of the horizontal protrusion at same time. Accordingly, the ~~core metal~~metal core can remarkably keep the durability of the adhesive surface, thereby reducing the shearing area between the ~~core metal~~metal core and the steel cords, and costs.

【0024】 Fig. 7 is an explanatory~~ining~~ view of a ~~core metal~~metal core showing a parting plane of a mold for producing the ~~core metal~~metal core of the first embodiment. Fig. 7A is a plane view of the side opposite the tread~~anti-tread side~~ of the ~~core metal~~metal core embedded in the rubber crawler track~~,~~; Fig. 7B is a side view; and Fig. 7C is a plane

view of the tread side.

In the first embodiment, the left and right guide protrusions of the~~core metal~~metal core are shifted in the circumferential direction so as to be arranged in a zigzag as shown in Fig. 1C and Fig. 3A. Therefore, as shown in Fig. 7, the parting plane of the mold is laterally shifted at the guide protrusions ~~side~~ and with the guide protrusions.

According to this, the height of the guide protrusion top on the central line of the ~~core metal~~metal core in the crawler longitudinal direction can be lowered, and the shape of the rolling plane is formed by the left and right guide protrusions in the~~core metal~~metal core longitudinal direction. Therefore, even~~core metal~~ a metal core with the horizontal protrusions can prevent ~~the~~ travelling vibration.

【0025】 Fig. 8 is a graph ~~view~~ showing the rolling-wheel sinkage of the conventional~~core metal~~metal core and the~~core metal~~metal core of the present invention. The conventional~~core metal~~metal core is produced by a conventional mold parting laterally, the guide protrusion top forming a trimming taper from the center. A mold used in the present invention is formed so as to shift the left and right guide protrusions longitudinally in the crawler circumferential direction and so as to shift the parting plane laterally at the guide protrusions ~~side~~ and with the guide protrusions.

As shown in Fig. 8, the sinkage varies greatly in the~~core metal~~metal core whose guide protrusion top forms the trimming taper because the rolling wheel sinks most near the center of the guide protrusion ~~most~~ and does not sink much at the ends. On the other hand, in the~~core metal~~metal core produced by the mold in the present invention, the sinkage is almost equal.

In this way, the invention of the first embodiment can prevent the traveling vibration suitably.

EXAMPLE 2

【0026】 Fig. 9 shows a~~core metal~~metal core 3' embedded in the rubber crawler body of the second embodiment. Fig. 9A is a plan~~e~~ view of the side opposite the tread~~anti-tread side~~, and Fig. 9B is a side view.

The~~ core metal~~metal core 3' has a tapered horn portion 7 on an end of the horizontal protrusion of one side in the crawler circumferential direction (~~core~~ metal core width direction). When the~~ core metal~~metal core 3' is embedded in the rubber crawler body, the ends of the horizontal protrusions 6' ~~facing~~ between ~~the~~ adjacent~~ core metal~~metal core s in the crawler circumferential direction overlap within a~~the~~ fixed length in the crawler width direction and in the crawler thickness directions. In this case, only one of the horizontal protrusions has the horn portion 7.

The~~ core metal~~metal core 3' in Fig. 9 will be explained. The horn portion 7 is provided on~~to~~ the horizontal protrusion 6a', not on~~provided to~~ the horizontal protrusion 6c' on~~of~~ the opposite side ~~plane~~ in the~~ core metal~~metal core width direction as shown in Fig. 9A. And, it is not provided on~~to~~ the horizontal protrusion 6b' opposite to the the horizontal protrusion 6a' in the~~ core metal~~metal core 3' longitudinal direction, but is provided on~~to~~ the horizontal protrusion 6d' having~~of the~~ point symmetry ~~side~~.

【0027】 Fig. 10 is a view for explaining the horizontal protrusions between the adjacent~~ core metals~~metal cores 3' of the second embodiment. Fig. 10A is an explanatory~~ion~~ view of the side ~~plane~~ showing the relation of the adjacent~~ core metals~~metal cores while the crawler track contacts ~~on~~ the ground (in a horizontal state). Fig. 10B is an explanatory~~ion~~ view of the side ~~plane~~ showing the relation of the adjacent~~ core metals~~metal cores while the crawler track is wound around~~up to~~ the idler and the sprocket of the traveling device.

As shown in Fig. 10B, the horn portions do not interfere with~~to~~ the~~ core metal~~metal cores adjacent to the horizontal protrusions when the crawler track is wound around~~up to~~ the idler and the sprocket. Accordingly, as shown in Fig. 10A, it is possible to shorten the distance between the horn portion 7 and the adjacent~~ core metal~~metal core when~~so that~~ the crawler track contacts ~~on~~ the ground. As a result, the overlap length of the horizontal protrusions between the adjacent~~ core metals~~metal cores is increased~~enlarged~~ to maintain~~keep~~ the overlap of the horizontal protrusions. Therefore, the crawler track is prevented from coming~~getting~~ off.

【0028】 It is not preferable to arrange the bottom end of the tread side of the

horizontal protrusion from the steel cord layer to the further tread side because the rubber portion of the horizontal protrusion is damaged by the ground.

In case the horizontal protrusion is provided to the tread side than the ~~core metal~~metal core bottom, the thickness portion may be provided to the ~~core metal~~metal core bottom portion.

Claims

1. A rubber crawler track, comprising:

a rubber crawler body shaped as an endless belt made of rubber elastic body;

a layer comprising a majority of steel cords embedded in said rubber crawler body; and

core metals embedded in said rubber crawler body at a fixed interval in a crawler circumferential direction,

each of said core metals comprising:

an engaging portion formed at the center of a core metal length direction;

guide protrusions for preventing wheel run-off;

wing portions,

said guide protrusions and said wing portions formed at both sides of the engaging portion; and

horizontal protrusions formed to side planes of the core metal in a width direction of at least one of the both sides of said engaging portion where are within a thickness of the wing portion in a core metal vertical direction and an area of anti-tread side portion below than the thickness,

said horizontal protrusions facing between adjacent core metals in the crawler

circumferential direction overlapping within a fixed length of their ends in a crawler width direction and in a crawler thickness direction;

wherein a distance "r" in the crawler circumferential direction between the ends of the horizontal protrusions is expressed as $\Delta r \leqq r \leqq 2\Delta r$ when the rubber crawler track is horizontal.

2. A rubber crawler track, comprising:

a rubber crawler body shaped as an endless belt made of rubber elastic body;

a layer comprising a majority of steel cords embedded in said rubber crawler body; and

core metals embedded in said rubber crawler body at a fixed interval in a crawler circumferential direction,

each of said core metals comprising:

an engaging portion formed at the center of a core metal length direction;

guide protrusions for preventing wheel run-off;

wing portions,

said guide protrusions and said wing portions formed at both sides of the engaging portion; and

horizontal protrusions formed to side planes of the core metal in a width direction of at least one of the both sides of said engaging portion where are within a thickness of the wing portion in a core metal vertical direction and an area of anti-tread side portion below than the thickness,

said horizontal protrusions facing between adjacent core metals in the crawler circumferential direction overlapping within a fixed length of their ends in a crawler width direction and in a crawler thickness direction;

wherein a tapered horn portion is provided to an end of the horizontal protrusion of one side of the adjacent core metals.

3. A method of producing a core metal for rubber crawler track, embedded in an endless

belt-shaped rubber crawler body made of rubber elastic body, said rubber crawler track including a majority of steel cords stratifiedly embedded at a fixed interval in a crawler circumferential direction, comprising:

forming an engaging portion at the center of said core metal in a core metal length direction;

forming guide protrusions for preventing wheel run-off and wing portions to both sides of said engaging portion;

providing horizontal protrusions to side planes in a core metal width direction of at least one side of the both sides of said engaging portion within a thickness of the wing portion in a core metal vertical direction and an area of tread side below than the thickness;

forming a parting plane of a mold for producing the core metal so as to be parted longitudinally in the core metal width direction;

shifting said parting plane laterally on the guide protrusions at the center of the core metal wing portions in a direction that the guide protrusions are shifted; and

shifting trimming tapers of guide tops of the guide protrusions left and right from the center of the core metal.

Abstract

A rubber crawler track in which a local side displacement is more effectively prevented to effectively prevent wheel run-off, which can reduce~~improve~~ traveling vibration, and in which separation of metal cores~~a core metal~~ is prevented for improved durability of the rubber crawler track and for reduced costs. The expression of $\Delta r \leqq r \leqq 2 \Delta r$ is satisfied, with "r" being the distance, in the circumferential direction of the rubber crawler track, between ends of horizontal protrusions (6) facing each other between adjacent ~~core metals~~metal cores (3) embedded in a rubber crawler body in a horizontal state of the rubber crawler track, "h" being the distance from a steel cord (5) layer embedded in the rubber crawler body to the core metal horizontal protrusions (6), and Δr being a value obtained by $\Delta r = 2\pi h / n$ where "n" is the number of sprocket teeth of a traveling device.